

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Kyle M. Hanson et al.
Filed : January 29, 2002
For : APPARATUS AND METHOD FOR ELECTROCHEMICALLY
PROCESSING A MICROELECTRONIC WORKPIECE
Docket No. : 29195.8122US1

PRIOR APPLICATION

Application No. : 09/531,828
Filing Date : 3/21/00
Examiner : Wesley A. Nicolas
Art Unit : 1741

Box Patent Application

Commissioner for Patents
Washington, DC 20231

PRELIMINARY AMENDMENT

Dear Commissioner:

Please amend the subject application as follows:

In the Specification:

On page 1, line 4, please replace the section labeled "CROSS-REFERENCE TO RELATED APPLICATIONS" with the following:

This application is a divisional of U.S. Patent Application No. 09/531,828, filed March 21, 2000.

In the Claims:

Please cancel claims 1-25 and 39-41. Please amend claims 26-28 and 34-36 as follows:

1. (Cancelled)

2. (Cancelled)
3. (Cancelled)
4. (Cancelled)
5. (Cancelled)
6. (Cancelled)
7. (Cancelled)
8. (Cancelled)
9. (Cancelled)
10. (Cancelled)
11. (Cancelled)
12. (Cancelled)
13. (Cancelled)
14. (Cancelled)
15. (Cancelled)
16. (Cancelled)
17. (Cancelled)

18. (Cancelled)

19. (Cancelled).

20. (Cancelled)

21. (Cancelled)

22. (Cancelled)

23. (Cancelled)

24. (Cancelled)

25. (Cancelled)

26. (Amended) A reactor for electrochemically processing a microelectronic workpiece comprising:

one or more walls defining a processing space for containing a processing fluid, the one or more walls forming a processing cup having an open top;

a microelectronic workpiece support including one or more conductive members disposed to electrically contact the microelectronic workpiece to provide electrical power for electrochemical processing of the microelectronic workpiece, the microelectronic workpiece support being disposed proximate the open top of the processing cup to bring at least one portion of the microelectronic workpiece into contact with the processing fluid for electrochemical processing,

an electrode housing disposed in the processing cup and having an end that opens toward the microelectronic workpiece support, the electrode housing having an interior region configured to receive at least one electrode;

a pressure drop member disposed over the open end of the electrode housing;

at least one processing fluid inlet disposed exterior to the interior region of the electrode housing to provide a flow of the processing fluid into the processing space;

at least one processing fluid outlet in fluid communication with the interior region of the electrode housing to generate a flow of the processing fluid through the pressure drop member and into the interior region of the electrode housing.

27. (Amended) A reactor as claimed in claim 26, further comprising the at least one electrode, and wherein the at least one electrode comprises an anode in the electrochemical processing of the microelectronic workpiece.

28. (Amended) A reactor as claimed in claim 26, further comprising the at least one electrode, and wherein the at least one electrode comprises a cathode in the electrochemical processing of the microelectronic workpiece.

29. A reactor as claimed in claim 26 wherein the at least one processing fluid outlet draws at least a portion of the flow of the processing fluid about the at least one electrode as the processing fluid exits from the interior region.

30. A reactor as claimed in claim 26 wherein at least a portion of the processing fluid entering the processing space exits from the processing space through the open top of the processing cup.

31. A reactor as claimed in claim 26 wherein the pressure drop member comprises a permeable membrane.

32. A reactor as claimed in claim 31 wherein, the permeable membrane is conical in shape having an apex directed toward the interior region of the electrode housing.

33. A reactor as claimed in claim 26 wherein the pressure drop member is conical in shape having an apex directed toward the interior region of the electrode housing.

34. (Amended) An apparatus for use in a reactor assembly used in electrochemical processing of a microelectronic workpiece, the apparatus comprising:

one or more walls defining a processing space therebetween for containing a processing fluid;

a pressure drop member disposed in the processing space to divide the processing space into at least a first fluid flow region and a second fluid flow region, the pressure drop member facilitating generation of a pressure drop thereacross, fluid flow during electrochemical processing of the microelectronic workpiece being from the second region into the first region across the pressure drop member, the first fluid flow region being configured to receive at least one electrode; and

a microelectronic workpiece disposed for contact with processing fluid in the second fluid flow region.

35. (Amended) A reactor as claimed in claim 34, further comprising the at least one electrode, and wherein the at least one electrode comprises an anode in the electrochemical processing of the microelectronic workpiece.

36. (Amended) A reactor as claimed in claim 34, further comprising the at least one electrode, and wherein the at least one electrode comprises a cathode in the electrochemical processing of the microelectronic workpiece.

37. An apparatus as claimed in claim 34 wherein the pressure drop member comprises a permeable membrane.

38. An apparatus as claimed in claim 34 wherein the first and second fluid flow regions are adjacent one another.

39. (Cancelled)

40. (Cancelled)

41. (Cancelled)

42. A method for electrochemically processing a microelectronic workpiece comprising the steps of:

dividing a processing space containing processing fluid into at least a first fluid flow region and a second fluid flow region,

locating a first electrode within the processing fluid of the first fluid flow region;

locating a second electrode comprising at least a portion of the microelectronic workpiece within the processing fluid of the second fluid flow region;

generating a fluid flow of the processing fluid within the first fluid flow region that is generally directed toward the first electrode and generally away from the second electrode; and

generating a fluid flow of the processing fluid within the second fluid flow region that is generally directed toward the second electrode and generally away from the first electrode.

43. A method as claimed in claim 42 and further comprising the step of providing a negative potential to the first electrode with respect to the second electrode.

44. A method as claimed in claim 42 and further comprising the step of providing a negative potential to the second electrode with respect to the first electrode.

45. A method as claimed in claim 42 wherein the step of generating the fluid flow of the processing fluid within the second fluid flow region comprises the step of supplying processing fluid from a fluid reservoir into the second fluid flow region of the processing space

46. A method as claimed in claim 42 wherein the step of generating the fluid flow of the processing fluid within the first fluid flow region comprises the step of exhausting at least a portion of the processing fluid from the first fluid flow region away from the processing space.

47. A method as claimed in claim 42 and further comprising the step of limiting the flow of processing fluid from the second fluid flow region into the first fluid flow region, thereby maintaining a pressure differential between the first fluid flow region and the second fluid flow region.

48. A method as claimed in claim 47 wherein the step of limiting the flow comprises the step of providing a permeable membrane between the first fluid flow region and the second fluid flow region.

49. An apparatus for use in electrochemical processing of a microelectronic workpiece comprising:

a processing space containing processing fluid;

at least one fluid inlet disposed to provide a flow of processing fluid to the processing space;

an electrode assembly disposed in the processing space comprising

an electrode housing having an open end,

a pressure drop member disposed over the open end of the electrode housing, the electrode housing and pressure drop member defining an interior electrode chamber,

an electrode disposed in the interior electrode chamber,

at least one fluid outlet in fluid communication with the interior electrode chamber to thereby draw a flow of processing fluid through the pressure drop member and into the interior electrode chamber.

50. An apparatus as claimed in claim 49 wherein the pressure drop member comprises a permeable membrane.

51. An apparatus as claimed in claim 50 and further comprising a membrane frame disposed over the open end of the electrode housing, the permeable membrane being connected to the membrane frame.

52. An apparatus as claimed in claim 49 wherein the pressure drop member has a conical shape with an apex directed toward the interior electrode chamber.

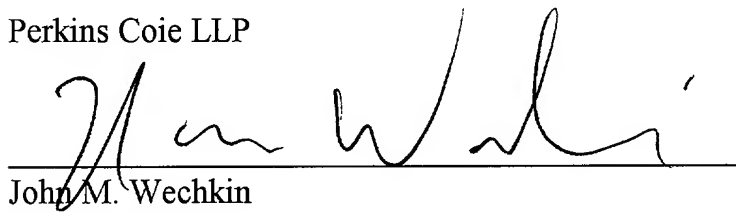
REMARKS

The specification has been amended to indicate that the present application is a divisional of pending U.S. Patent Application No. 09/531,828 (the '828 application). Claims 1-25 and 39-41 have been cancelled from the present application. Claims 26-28 and 34-36 have been amended in a manner that does not narrow the scope of the claims. Claims 26-38 and 42-52 were cancelled in the '828 application in response to a restriction requirement and are now resubmitted for examination.

Please consider the application in light of the above amendments. The Examiner is encouraged to contact the undersigned at (206) 287-3257 if there are any questions regarding these amendments.

Respectfully submitted,

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Enclosures:

Appendix (Marked-up version of claims)

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**Appendix – Specification Paragraph
Marked to Show Changes**

~~Not applicable.~~ This application is a divisional of U.S. Patent Application No. 09/531,828, filed March 21, 2000.

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**Appendix – Claims
Marked to Show Changes**

26. (Amended) A reactor for electrochemically processing a microelectronic workpiece comprising:

one or more walls defining a processing space for containing a processing fluid, the one or more walls forming a processing cup having an open top;

a microelectronic workpiece support including one or more conductive members disposed to electrically contact the microelectronic workpiece to provide electrical power for electrochemical processing of the microelectronic workpiece, the microelectronic workpiece support being disposed proximate the open top of the processing cup to bring at least one portion of the microelectronic workpiece into contact with the processing fluid for electrochemical processing,

an electrode housing disposed in the processing cup and having an end that opens toward the microelectronic workpiece support, the electrode housing having an interior region configured to receive at least one electrode;

a pressure drop member disposed over the open end of the electrode housing;

~~at least one electrode disposed in an interior region of the electrode housing;~~

at least one processing fluid inlet disposed exterior to the interior region of the electrode housing to provide a flow of the processing fluid into the processing space;

at least one processing fluid outlet in fluid communication with the interior region of the electrode housing to generate a flow of the processing fluid through the pressure drop member and into the interior region of the electrode housing.

27. (Amended) A reactor as claimed in claim 26, further comprising the at least one electrode, and wherein the at least one electrode comprises an anode in the electrochemical processing of the microelectronic workpiece.

28. (Amended) A reactor as claimed in claim 26, further comprising the at least one electrode, and wherein the at least one electrode comprises a cathode in the electrochemical processing of the microelectronic workpiece.

34. (Amended) An apparatus for use in a reactor assembly used in electrochemical processing of a microelectronic workpiece, the apparatus comprising:

one or more walls defining a processing space therebetween for containing a processing fluid;

a pressure drop member disposed in the processing space to divide the processing space into at least a first fluid flow region and a second fluid flow region, the pressure drop member facilitating generation of a pressure drop thereacross, fluid flow during electrochemical processing of the microelectronic workpiece being from the second region into the first region across the pressure drop member, the first fluid flow region being configured to receive at least one electrode; and

a microelectronic workpiece disposed for contact with processing fluid in the second fluid flow region, ~~and~~

~~an electrode located in the first region of the processing space.~~

35. (Amended) A reactor as claimed in claim 34, further comprising the at least one electrode, and wherein the at least one electrode comprises an anode in the electrochemical processing of the microelectronic workpiece.

36. (Amended) A reactor as claimed in claim 34, further comprising the at least one electrode, and wherein the at least one electrode comprises a cathode in the electrochemical processing of the microelectronic workpiece.